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MAPPING THE SMALL ARMS TRADE: INSIGHTS FROM SOCIAL NETWORK ANALYSIS

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Abstract

In recent years, researchers have increasingly turned their attention to the proliferation of small arms, a transnational trade amounting to over \$7 billion in value during 2002. Small arms are difficult to track and are not the stuff of military parades, but they are immensely destructive. The trade in small arms should be understood not as a market but as a network, one that shares some important properties with networked forms of organization studied by sociologists. I make this argument and then employ quantitative methods developed for the study of social networks in an effort to show the basic structure of both legal and illegal small arms transfers. My analysis is drawn from a database that is still in its early stages of development, so the results are preliminary, but they are suggestive and the analytical approach promises to shed considerable light on a corner of the global arms trade that is of great interest to the research and activist communities, and of great consequence to those in war-torn regions of the world.

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MAPPING THE SMALL ARMS TRADE: INSIGHTS FROM SOCIAL NETWORK ANALYSIS

An estimate of the global value of small arms production in 2002 is \$7.4 billion. Well over 1,000 companies manufacture light weapons and ammunition in nearly 100 countries. More than half of what is manufactured, \$4 billion worth, is transferred legally across national borders, while as much as \$1 billion worth enters the international black market (Small Arms Survey 2003; Marsh 2002). Credible estimates have only become available in recent years as arms trade researchers, international organizations, and activists have increasingly turned their attention to what was once merely a footnote in scholarship and policymaking on matters of proliferation and arms control. Far more people are killed by rifles, pistols, grenades, and landmines (not to mention machetes) than attack aircraft, main battle tanks, and missiles. Small arms are, in a very real sense, weapons of mass destruction.

Most small arms transfers are economic exchanges, but they are often exchanges governed by more than market forces. As such, they are the type of transactions of interest to sociologists dissatisfied with the neoclassical economic approach to social organization, which is judged as excessively utilitarian and insufficiently attentive to the impact of social relations on economic behavior. Nor are arms transfers governed by hierarchical authority, as are exchanges within vertically integrated firms or conglomerates, the emergence of which are often explained as a response to market transaction costs.

In between the hierarchy of the firms and the anarchy of the market are network forms of organization and exchange. They depend not on formal authority, but on shared interests and ongoing relationships. Whereas market transactions are undertaken to maximize returns in the

short and medium term, network exchanges are sequential and contribute to an overall pattern of enduring interaction. Because the mechanism of governance rests largely on trust and obligation, network forms of organization function well when composed of homogenous groups of actors. The opportunism and guile contributing to high transaction costs in the impersonal market setting is less common among those sharing professional, ethnic, or ideological backgrounds, and thus hierarchical governance structures are less likely to emerge.

The small arms trade is characterized by some of the same features found in network forms of economic organization. Decisions to supply and purchase weaponry are often elements in ongoing arms-transfer relationships, which are sometimes part of more general military relationships. This holds whether the actors in question are states or nonstate entities, like rebel groups or paramilitary organizations. While particular arms-transfer agreements may ostensibly take the form of arms-length contracts, much of their meaning is lost if they are extracted from this “social context.” Instead of contracts, they may actually resemble longer-term investments in mutually beneficial relationships. Of course, not all small arms transfers – legal or illegal, between states or nonstate actors – are of this sort, so thick with meaning. Many do resemble market transactions in which little more is involved than the sale of military hardware by one party to another.

This paper is a preliminary examination of the international trade in small arms, both legal and illegal, conceptualized as a social network. It is preliminary in two ways. First, I am in the fairly early stages of collecting data on small arms transfers, an effort that involves coding information contained in news accounts from various sources, and here I conduct an analysis of a subset of events for which the data are reasonably complete for my purposes. Second, the

method of analysis used in this paper, social network analysis (SNA), consists of a large number of both descriptive and inferential techniques. The techniques most appropriate for mapping the small arms trade are the descriptive ones, but it is also the case that any mapping using descriptive methods is likely to be sensitive to missing and noisy data. Nevertheless, with these caveats on the table, I want to give some sense of the main locales involved in legal and illegal small arms trade, as well as the availability of information and the usefulness of network analytical methods for distilling that information. Before moving on to the empirical analysis, however, I will expand on my rationale for treating the small arms trade as a social network.

THE ARMS MARKET?

A market is a social entity that governs transactions between producers and consumers by way of a price mechanism, and economists typically locate pure markets at one end of a range of possible arrangements for the exchange of goods and services. This is the anarchic end. No authority is exercised in a pure market; economic production is governed by prices, which result from individual decisions affecting supply and demand. At the hierarchical end are organized social entities like firms. Within a firm, economic production is governed by an entrepreneur, whether an individual or a collective, who directs the allocation of resources within the organization. One of the questions that has occupied economists is: Under what circumstances do markets give rise to hierarchical organizations as a means of coordinating economic exchange?

The classic treatment of this issue is by Coase (1937, 392), who maintained that “the operation of a market costs something and that, by forming an organization and allowing some

authority (the ‘entrepreneur’) to direct the resources, certain marketing costs are saved” (see also Lindblom 1977, chap. 3). In contemporary scholarship, these sorts of costs are termed “transaction costs,” and they generally derive from the inefficiencies associated with incomplete information (e.g., Williamson 1981). Some economic transactions involve uncertainties – e.g., about continued access to specialized inputs into the production process – and although these might be handled by entering into contracts, the continual negotiation and renegotiation of contracts is costly. Such transaction costs, at least some of them, can be eliminated if the parties enter into an exchange relationship governed according to the bylaws of a hierarchical organization. Under these circumstances, firms will realize efficiencies not available in the open market and economic production and exchange will become more profitable.

Where should we locate the global arms trade on the anarchy-hierarchy continuum? In the international system, states can be treated as the analogues to firms in the market (Waltz 1979). Their internal affairs are organized hierarchically, but sometimes they choose, in their external affairs, to collaborate with others as members of intergovernmental organizations. Such collaboration is initiated with the signing of treaties or charters, which are essentially contracts. Occasionally, states have taken small steps toward vertical integration, whereby certain international organizations are endowed with a degree of supranational authority over their activities in specific functional areas. But no such entities exist today that direct or coordinate the arms transfer policies of supplier states. The closest approximations, both of which seek to set limits on the conventional arms trade, are the Wassenaar Arrangement and the Missile Technology Control Regime (MTCR). However, both agreements bear more resemblance to arm’s-length contracts (largely unenforceable) among independent firms than they do

hierarchical arrangements in which supranational authority can be exercised over member states' arms-supply decisions. Wassenaar and the MTCR are no different from other arms control agreements in this respect.

The Wassenaar Arrangement was fashioned as a replacement for the Coordinating Committee for Multilateral Export Controls (CoCom), a mechanism established by the United States and its allies to restrict high-technology exports to Soviet bloc. With the end of the cold war, attention shifted to containing the flow of advanced weaponry and military technology to potentially unstable parts of the world, which has typically meant select rogue regimes and conflict-ridden regions. Wassenaar, whose thirty-three member states include most of the countries once targeted by CoCom, aims at “preventing destabilizing accumulations” of military equipment and technology “by promoting transparency and greater responsibility” in the policies of arms suppliers.¹ Participants have agreed to exchange information on major weapons exports to non-Wassenaar states, as well as the transfer of sensitive dual-use goods and technology. In contrast to CoCom, member states do not have a veto over other members' transfers of controlled goods, although for the subset of very sensitive items on the technologies list, Wassenaar calls on members to exercise “extreme vigilance” and foresees the coordination of binding national criteria for export control.

Whatever their differences, the logic supporting the Wassenaar Arrangement seems to be similar to the one behind CoCom – what Stein (1983) has called a dilemma of common

¹ See Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, “Initial Elements” (adopted in 1996, amended in 1999, 2001 and 2002); available at <<http://www.wassenaar.org/docs/IE96.html>>.

interests.² All suppliers have an interest in curbing the transfer of military technology to the extent that proliferation threatens to “blowback” and chip away at their own national security. However, each supplier profits by exporting weaponry, especially if that state’s defection does not undermine the collaborative restraint exercised by others. Thus, the choice faced by suppliers often takes the form of a prisoner’s dilemma. Yet each supplier’s incentive to free ride creates a collective action problem resulting in Wassenaar’s feared “destabilizing accumulations,” a jointly suboptimal outcome for all suppliers.

It is perhaps useful to understand CoCom and Wassenaar, as well as other current arrangements like the MTCR and the Nuclear Suppliers Group, as collective efforts to deal with transaction costs.³ When states produce military goods and technology for export, they hope to profit in various ways: politically, by winning friends and allies and possibly gaining some influence over recipients’ foreign and military policies; economically, by generating sales revenue for the defense-industrial sector and thus tax revenue for the state; and militarily, by maintaining the health of the defense-industrial base and by solidifying alliances with recipients, if alliances exist. The realization of these gains is uncertain under the best of circumstances, but the uncertainties are magnified in the context of unrestrained competition among arms suppliers for customers. That is, competition among suppliers in the arms market threatens future political, economic, and military “revenue streams,” making arms transfers a more uncertain and

² The most thorough political analysis of CoCom in recent years is Mastanduno (1992). For an examination of CoCom in the context of a game theoretic analysis of sanctions regimes, see Martin (1992, chap. 7).

³ Lipson (1999) considers this type of explanation for the creation of the Wassenaar Arrangement, but finds it wanting. On the MTCR, see Mistry (2002).

therefore costly tool for transacting foreign policy.

The creation of export control regimes suggests that states are making efforts to avoid such suboptimal outcomes, but Wassenaar and other arrangements fall considerably short as analogies to the hierarchical firms theorized by economists. Indeed, Lake (1996) locates the NATO alliance, a much more formal security relationship than the Wassenaar Arrangement, at the anarchy end of the continuum. In contrast to empire, an alternative (if rare) means of achieving security, alliances and less formal arrangements are better understood as contracts among independent actors. This does not mean they are always successful in achieving their aims. To be sure, Wassenaar and the MTCR have been widely criticized as inadequate. Dilemmas of common interest are plagued by the same sort of opportunism – or, as Williamson (1981, 554) puts it, “self-interest seeking with guile” – that undermines contracting among economic agents.

THE ARMS-TRANSFER NETWORK

Patterns of economic exchange governed by more than market forces but by less than hierarchical organizations have been of considerable interest to sociologists. Granovetter (1985), for instance, has echoed the common criticism of the neoclassical economic approach to organization as offering a utilitarian and “undersocialized” conception of human action in which little allowance is made for the impact of social relations on economic exchange (except as a drag on the efficient allocation of resources). At the same time, early sociological correctives tended to propose “oversocialized” conceptions of behavior whereby individuals simply, and somewhat robotically, internalize societal norms, also leaving little room for the impact of

ongoing social relations (see also Wrong 1961). For Granovetter and others, economic behavior is governed not only by institutional arrangements designed to discourage malfeasance and reduce transaction costs, or by a “generalized morality” instilled through the socialization process, but also by trust. Economic action is embedded in ongoing social interaction and more emphasis needs to be placed on “the role of concrete personal relations and structures (or ‘networks’) of such relations in generating trust and discouraging malfeasance” (Granovetter 1981, 490).

A similar gap seems to exist in the political science literature on international organization. Liberals have criticized realists for failing to see international institutions as more than epiphenomena deriving from the distribution of state power. Instead, taking cues from new institutional economics, liberals see them as “information-providing and transaction cost-reducing entities” (Keohane 1984, 101). Constructivists, in turn, taking cues from the institutional approach in sociology, fault liberals (and realists) for neglecting “the production and reproduction of identities and interests” and for assuming that “how states treat each other in interaction does not matter for how they define who they are” (Wendt 1999, 36; see also Finnemore 1996).⁴ But to date the focus of constructivist analysis has been on the socialization of states – “states are people too,” Wendt (1999, 215) says – and on the emergence and reinforcement of norms in international society, rather than on relations between states and

⁴ This argument between realists, liberals, and constructivists fills many pages in the international relations literature (too many, I think). For a shortcut through the debate, see Mearsheimer (1994/95) and the follow-on symposium on institutions in the summer 1995 issue of *International Security*.

outcomes that fall short of norm creation and institution building.⁵

In departing from transaction-cost explanations, sociologists who study economic organization are not abandoning the notion of rational action. They are suggesting that social constraints, or “embeddedness,” often makes seemingly nonrational behavior appear quite reasonable. Many economic transactions “aim not only at economic goals but also at sociability, approval, status, and power” (Granovetter 1985, 506). In realm of world politics, those studying the arms production and transfer system have frequently observed that the arms acquisition policies of both developed and developing states don’t always make sense in terms of either military or economic efficiency. The “rationality” of those procurement patterns becomes apparent only when taking into account less material motives like status, prestige, and the symbols of modern statehood (e.g., Kaldor 1981; Suchman and Eyre 1992; Eyre and Suchman 1996; Wendt and Barnett 1993; Kinsella and Chima 2001). And no less an authority than Hans Morgenthau (1985, 86-87), realism’s chief exponent, believed that “prestige, however exaggerated and absurd its uses may have been at times, is as intrinsic an element of the relations between nations as the desire for prestige is of the relations between individuals.”

Inquiry into the role of social relations in the emergence of various forms of economic organization is of fairly recent origin in sociology. But much of the research that has been done on interpersonal relations in economic life focuses on the creation and maintenance of social networks. Less anarchic than markets, networks of economic actors are at the same time not

⁵ The individualist orientation of the realist and liberal traditions in international relations theory probably guards against any tendency that constructivists might have to adopt an oversocialized conception of state action. Constructivists’ preoccupation with norms, institutions, and identity formation, instead of interstate relationships, is perhaps temporary – due less to the ontology of constructivism than to its newness to the field.

hierarchically organized. Where price serves as a control mechanism in markets and authority serves that function within a vertically integrated firm, personal relationships, typically characterized by trust and a norm of reciprocity, are the glue that binds a social network together. It may well be that, under conditions conducive to social networks, hierarchically organized social entities are not required as a means of reducing uncertainty and managing transaction costs, but from a sociological point of view that begs some important questions. What are those conditions? To what extent can they be explained by the social, cultural, and political practices that embed economic interaction? Alternatively, to what extent can they be explained by the nature of particular forms of economic exchange?

Powell (1990) addresses the last of these questions, maintaining that some forms of exchange are inherently more social than others. They depend not so much on formal authority, but on shared interests and ongoing relationships. In network forms of exchange, “the entangling of obligation and reputation reaches a point that the actions of the parties are interdependent.” The pattern of interaction “looks more like a marriage than a one-night stand, but there is no marriage license, no common household, no pooling of assets” (Powell 1990, 301). Whereas market transactions are undertaken to maximize returns in the short and medium term, network exchanges are sequential and contribute to an overall pattern of enduring interaction. Much of what is exchanged in social networks is difficult to price – know-how and styles of production, for example – so the flow of information through networks is often “richer” than what is transmitted by the price mechanism in markets or by controlled channels of communication within a vertically integrated firm. Finally, because the mechanism of governance rests largely on trust and obligation, network forms of organization function well when composed of

homogenous groups of actors. The opportunism and guile contributing to high transaction costs in the impersonal market setting is less common among those sharing professional, ethnic, or ideological backgrounds, and thus hierarchical governance structures are less likely to emerge.

State-sanctioned Arms Transfers

The arms trade is characterized by some of the same features found in network forms of economic organization. Decisions to supply and purchase weaponry are often elements in ongoing arms-transfer relationships. In the case of state-sanctioned transfers, they are elements of more general military relationships. The supply of finished weapons systems can be accompanied by instruction in the operation and maintenance of equipment, construction of support facilities, and other forms of technical assistance. Arms transfers are, in many instances, embedded in relationships of mutual defense – e.g., weapons flows between members of formal military alliances like NATO – or in less formal commitments by suppliers to the security of recipient states. Those more general military relations, whether formal or implied, may also involve basing and overflight rights, military training and joint exercises, the coordination of strategy and tactics, the sharing of military intelligence, and other forms of collaboration intended to enhance the security of both parties to the transaction. While particular arms-transfer agreements may take the form of arms-length contracts, much of their meaning is lost if they are extracted from this “social context.” Instead of contracts, they may actually resemble long-term investments in mutually beneficial interstate relationships.

Consistent with Powell’s (1990) description of exchanges within networks, it is difficult to attach a value to the political and military commitments that often accompany arms transfers

between states. In addition to interstate commitments, weapons supplies embody the transfer of military technology, and many deals include arrangements for the licensed production of military equipment by the recipient. This flow of technology and know-how between states, which is also hard to price, is an important feature of the contemporary arms trade and has had a measurable impact on the emergence of a “third tier” of arms producers in the international system (Krause 1992; Bitzinger 1994; Kinsella 2000). Thus, the information and meaning embodied in arms transfers can be substantially richer than what might be indicated by the market or military-use value of the weapons themselves.

Much more is involved in these transactions than a shipment of some increment of destructive capability from one to another state. Because arms transfers are indicative of the supplier’s commitment to the recipient’s security, as well as the recipient’s expectation (perhaps backed up with certain concessions) that it can count on this commitment into the future, the most significant and enduring arms-transfer relationships link states with congruent foreign policy orientations. During the cold war, for instance, the United States and its allies tended to supply arms to states whose policies were generally in accord with the global political-economic status quo, while the Soviet Union and its allies tended to supply dissatisfied or revisionist states (Kinsella 1994). There was, then, in the arms-transfer network a certain homogeneity among states with the closest and most dependable ties. Such shared foreign policy orientations are not unlike the shared backgrounds (professional, ethnic, religious) that help sustain social networks comprised of individuals.

Black Market Transfers

Of course, not all arms transfers between states are of this sort, so thick with meaning. Many do resemble market transactions in which little more is involved than the sale of military hardware by one party to another. Indeed, illicit arms transfers by private dealers are typically undertaken solely for reasons of economic gain, so it might seem that the market conceptualization ought to work well in this realm of the global arms trade. Yet illegal weaponry clearly does flow through transnational networks, as do narcotics and other contraband; on its face, “networkness” seems to be a more obvious feature of the black market arms trade than does its “marketness.”

When comparing market and network forms of organization – and one could imagine hybrid forms as well (Bradach and Eccles 1989) – it is probably useful to distinguish between the nature of the goods being exchanged and the mode of exchange. Above I suggested that states transfer arms, or sanction the transfer of arms, for reasons other than (or in addition to) economic gain, that arms transfers embody security commitments as well as raw military capability. Analogous commitments usually do not attach to black market transfers, at least those involving private dealers and their brokers, but other types of commitments are involved that lend these transactions to network forms of organization. Specifically, because these arms transfers are illegal and must be kept out of view, the transactions that enable them – deal-making, document forgery, financial transfers, illicit transport, and so on – also must be kept out of view, and parties to the transaction must trust each other in this regard. Furthermore, in many cases, the parties to such transactions anticipate the need for future exchanges, and therefore would like to be able to return to, or reactivate, these transfer channels as those needs arise. Their options are kept open

by a set of mutual understandings and commitments to the maintenance of the social network.⁶

I am suggesting that, in the black market, transferred weaponry is not itself indicative of shared interests – say, common political or ideological goals that are furthered by the recipient's enhanced military capability. But the parties' separate interests – economic, military, or otherwise – surely are served by the black market infrastructure. Political, ideological, or other religious and ethnic attachments, may be relevant in a different way, however. Because black market arms transfers occur in a lawless environment, one without formal mechanisms of contract enforcement, parties to these transactions must rely more heavily on trust (often reinforced by threat) than is the case for legal market transactions. This is why many criminal organizations recruit members close to home. The social cohesion created by ethnic, religious, or ideological bonds reduces the likelihood of defection and thus the risks of operating in an extralegal environment.

More theoretical work needs to be done in order to fully conceptualize the global arms trade, and its multiple legal and illegal forms, as a social network. Perhaps it is somewhat premature, then, to proceed with empirical analysis. Nevertheless, I believe that the network characteristics of the arms trade, and especially the black market trade, are sufficiently compelling that it is appropriate to simultaneously explore its structural features using some of the quantitative methods developed for social network analysis.

⁶ Duffield (2000) examines the key features of transborder trade, including the illicit arms trade, in the context of civil war (see also Kaldor 2001, chap. 5; Cooper 2002). Insightful discussions of black market arms transfers also include Marsh (2002), Wood and Peleman (1999), and essays in Lumpe (2000).

SOCIAL NETWORK ANALYSIS

The focus of social network analysis (SNA) is less on the attributes or behavior of actors than on the structural dimensions of their social environment, which are distilled from the overall pattern of relationships or exchanges among the actors. The “social network” itself is defined as the group of actors and the relationships or interactions that link them, and SNA methods are applied once it is assumed (or demonstrated) that a group of actors constitutes a network. That is, SNA is not a means of distinguishing networks from other forms of social organization, like anarchical or hierarchical forms, nor does it provide a way to assess how “networky” a given social grouping is or is not. The premise of SNA is that the organization of a set of interrelated actors bears some resemblance to a social network and that it is therefore useful to examine its structural dimensions.⁷

Small Arms Data

In a previous paper, I used SNA methods to examine the structure of the global arms trade in major weapons at various points during the 1950-2000 period (Kinsella 2003). In that analysis, states were the network actors. States are also the actors for purposes of the present examination, which focuses on the trade in small arms. In the case of legal transfers, that is not problematic since these are state-sanctioned transfers, even if particular deals are not always scrutinized by government officials. In the case of black market transfers, states are the network actors in the sense of being the physical locale of nonstate suppliers and recipients. Of course, territorial

⁷ The most authoritative and comprehensive guide to the methods of social network analysis is probably Wasserman and Faust (1994). For a briefer overview, see Scott (2000).

states are merely the locales of private arms manufacturers involved in legal transfers as well, but I want to acknowledge that it seems particularly important to disassociate actors from states when it comes to analyzing the black market. Subsequent analyses black market transfers will focus on the identity of these nonstate actors, rather than equate them with their territorial-state location.

Small arms and light weapons are generally understood to include pistols, rifles, assault rifles, carbines, machine guns, hand-held and mounted grenade launchers, portable anti-tank and anti-aircraft guns, portable missile launchers, and small caliber mortars. Two groups are at the forefront of compiling and systematizing information on the small arms trade: the Small Arms Survey, based at the Graduate Institute of International Studies in Geneva, and the Norwegian Initiative on Small Arms Transfers (NISAT), affiliated with the International Peace Research Institute in Oslo. The Small Arms Survey is building a publicly accessible database consisting of government publications and statements pertaining to the small arms trade, but the *Small Arms Survey* yearbook is primary means by which the group distributes its data. NISAT maintains an Internet database consisting of tallies of state-to-state transfers of small arms and light weapons, as well an archive of news reports on the black market arms trade. Another source of information is the “Weapons Trade Observer” (WTO) electronic mail list maintained by David Isenberg, an independent analysts based in Washington, DC. Subscribers receive news reports on all aspects of the arms trade, including small arms transfers and the black market, pulled from various sources on the Internet. The data analyzed in this paper are distilled from the stories distributed via the WTO list. Subsequent investigations will draw on the other information sources as well.

The database consists of small arms-transfer “events,” legal and illegal, described in news

stories and commentaries, coded according to a set of rules. Each line, or unit of observation, in the database is a single event, defined as coterminous with a particular arms shipment's journey from source to recipient. The textual reports vary widely in the amount of useful information contained therein. Some reports include detailed accounts of arms shipments from manufacturer to purchaser, including any number of intermediary brokers, while other reports contain no codable information at all. Some reports pick up the shipment's journey midstream, as when one military organization supplies another organization, without any indication of where the first group acquired its weaponry.

Even if all of the reports contained complete information on each arms transfer, the transfer events themselves would exhibit a wide range of forms. The most obvious variation concerns those small arms transfers that are legal and those that are not. Legal transfers are typically characterized by an export license possessed by the supplier and an end-user certificate issued on behalf of the recipient. Black market transactions are transfers that lack one or both of these, including transfers that involve diversions part way through what would have otherwise been a legal transfer. (The "grey market" is sometimes used to classify transfers that start legal but end up illegal.) Black market transfers themselves display variation in the number and type of intermediaries or brokers engaged in the transaction, the nature of the illegality (e.g., forged end-user certificates, arsenal theft, etc.), and whether the transfer was intercepted by state authorities or someone else other than the intended recipient.

The informational requirements for the present analysis are minimal. State actors (or locales) are members of the network if they were parties to at least one arms-transfer during the period from September 2000 to February 2002, the time span for which I have coded data, and if

there was sufficient information to identify the actor (or locale) at the other end of the transaction. The network representing the legal transfer of small arms consists of 92 states with 174 links among them; the black market network consists of 53 states with 71 links. The network models are derived from 220 legal transfer events in my database (so far) that meet the informational requirement, and 204 illegal transfer events. No other information from the database is used here.

Actor Centrality

To repeat, arms suppliers and recipients, associated with territorial states, are the *actors* in the network and the existence of a relational *tie* or *link* is indicated by whether a particular actor transferred weapons to another actor. (Henceforth, my references to “state” should be understood as meaning an arms supplier or recipient located within a state.) An arms transfer is a *directed* tie in that it represents the flow of military resources from one state to another.⁸ Figures 1 and 2 are the “sociograms” for the legal and illegal small arms networks, respectively. While it is clear that the legal trade in small arms is the denser of the two networks, the black market network is sure to be denser than is indicated by Figure 2, given that much of it remains beyond the view of investigative journalists, no matter how tenacious. It is best to recognize that both maps are incomplete; fuller and more accurate maps must await further data collection. To the extent that the tip of the iceberg is representative of what remains submerged, however, we can get some sense of the most important actors.

⁸ Some SNA methods are adapted from graph theory in mathematics, so networks are often referred to as graphs consisting of nodes or vertices (actors) and lines or edges (ties). See Barnes and Harary (1983) and Harary, Norman, and Cartwright (1965).

[Figures 1 and 2 about here]

The network data are arranged as a square “sociomatrix” in which there is both a row and a column for each state in the network. A cell in the matrix contains a 1 if the state represented by row i , designated n_i , transferred arms to a state in column j , designated n_j , in which case $x_{ij} = 1$; otherwise $x_{ij} = 0$. The main diagonal of the sociomatrix, where $i = j$, is ignored.⁹ The *outdegree* of state i , $d_o(n_i)$, is the number of other states to which n_i has transferred arms; *indegree*, $d_i(n_j)$, is the total number of states supplying arms to n_j . That is,

$$d_o(n_i) = \sum_{j=1}^g x_{ij} \quad \text{and} \quad d_i(n_j) = \sum_{i=1}^g x_{ji} ,$$

which are, respectively, the row i and column j totals of the sociomatrix. If there are g states in the network, the maximum number of directed ties between states is $g(g-1)$. In most social networks, certain actors are more prominent than others, maybe because they are elites, and the evidence of their prominence is often the number and type of social ties they maintain with other actors. In the arms trade network, the leading arms suppliers occupy such positions of prominence. The *centrality* of a network actor is sometimes indexed as its outdegree or indegree (or both), but since these measures are greatly affected by the number of actors in a network, it is useful to normalize the index, especially for purposes of cross-temporal comparison. Thus, a

⁹ There are SNA procedures that work with valued data – in the present context, for example, the total dollar equivalent of arms transferred between states – but my analysis is based only on binary data indicating the presence or absence of an arms transfer in a particular year. Some more elaborate techniques, including some statistical estimators, make use of information about the attributes of actors as well as their ties. See Wasserman and Faust (1994, chaps. 10 and 15).

normalized centrality index for arms suppliers, $C'(n_i)$, can be computed as

$$C'(n_i) = \frac{d_o(n_i)}{g-1}.$$

If a state supplied weapons to every other state in the network, it would have a centrality measure of 1. The centrality index for recipients is computed similarly, except that indegree, $d_i(n_j)$, is used in the numerator.

After computing centrality indexes for the actors in the network, the sociograms displayed in Figures 1 and 2 can be rearranged to highlight prominent and peripheral actors. In the centrality maps shown in Figures 3 through 6, each state is positioned in one of five concentric rings corresponding to its centrality as either an arms recipient or an arms recipient. Keep in mind that the more central actors are those with more links to other states, not those that import or export more small arms measured in terms of volume. (The volume of weaponry flowing between actors can be factored into the computations as the database develops.) The most frequent destinations for small arms transfers, both legal and illegal, come as no surprise. African countries experiencing internal wars and rebellion – Somalia, Rwanda, Algeria, Angola, Congo, Uganda, Burkina Faso, Sierre Leone, Liberia – are located nearer the center of Figures 3 and 5, as are other conflict-ridden countries like Colombia and Afghanistan. The United States is an active small arms supplier, as we might expect given its position as the dominant supplier of major weapon systems, as are Russia, China, and Turkey (Figure 4). Former Soviet bloc countries – Bulgaria, Ukraine, Rumania, Slovakia – are also active, most notably in the black market (Figure 6).

[Figure 3, 4, 5, and 6 about here]

Structural Equivalence

A different kind of mapping can shed light on the structural positions of arms suppliers and recipients. A “position” in a social network is understood as a particular set of relations with particular groupings of actors. Two or more actors who occupy similar positions in the network structure have similar relations with those groupings. Two or more actors are *structurally equivalent* if they have exactly the same ties to all other actors in the network. Rarely are actors structurally equivalent, except in trivial ways, so the task for SNA is to determine how close actors’ positions are to one another.

The Euclidean distance between actors i and j , d_{ij} , is measured based on the presence or absence of relations with all other actors in the network. This distance can be computed with respect to either directed or undirected ties, but my interest here is directed ties – i.e., arms supplies from i and j to the $g - 2$ other states, as well as arms receipts by i and j . Therefore,

$$d_{ij} = \sqrt{\sum_{k=1}^g (x_{ik} - x_{jk})^2}$$

for $i \neq k$ and $j \neq k$. This is simply the total difference between row i and row j of the sociomatrix. For structurally equivalent actors, $d_{ij} = 0$, and for all other pairs, $d_{ij} > 0$. The maximum Euclidean distance between a pair of actors, occurring when the pair has different ties to all $g - 2$ other actors, is $\sqrt{2(g - 2)}$. The pairwise distances between arms suppliers is used to construct a symmetric $g \times g$ matrix, $\mathbf{D} = \{d_{ij}\}$, and this new distance matrix becomes the raw data for a map of the arms trade network in two-dimensional space. For purposes of visualization, the distances between the actors on this map should correspond as closely as possible to the Euclidean distances in \mathbf{D} , and to that end multidimensional scaling (MDS) can be employed to obtain each

actor's coordinates in two dimensions from the distance matrix.

Figures 7 through 10 are structural maps of the legal and illegal small arms trade. Note that each state's position is determined by essentially two discrete bits of information: the number of links to other states, whether as a supplier or a recipient, and the identity of those other states. In Figure 7, the clump of countries close to the origin, are those with very few arms-transfer ties to the other states. For the those states farther from the origin, exact position is determined also by the identity of their arms suppliers. (Frankly, I'm not sure there are any noteworthy patterns in this figure.) According to Figure 9, the recipients of black market transfers are more clearly arrayed on two dimensions. The African countries located in the southwest quadrant are structurally similar in that their shipments have come from former Soviet bloc countries (located near the origin). The countries in the southeast quadrant display somewhat less structural similarity, due to a more varied set of suppliers.

[Figures 7, 8, 9, and 10 about here]

Figures 8 and 10 map the positions of states as arms suppliers. In each figure, there is a clustering of a large number of countries near the origin, these being states that are predominantly recipients of small arms transfers and not suppliers. The structure of the legal small arms trade looks similar to that of the major weapons trade (see Kinsella 2003). The former cold war rivals are the most active suppliers, but their clientele is composed of different sets of states, as indicated by their orthogonal positions on the map (Figure 8).¹⁰ The most active states in the black market include a more diverse group, again with eastern European countries

¹⁰ The position of Afghanistan on this map is somewhat curious (see also Figure 4). I need to check that the coded events did in fact involve Taliban-sanctioned transfers, as opposed to black market transfers or transshipments through Afghan territory.

standing out. The destination of arms shipments from Bulgaria, Romania, Ukraine, and Russia distinguish these suppliers from others like Nicaragua, Israel, and the United States.

CONCLUSION

Network forms of organization are nonanarchical and nonhierarchical. Relations among actors in networks are guided by mechanisms of “governance without government,” and such mechanisms are manifest in many realms of international and transnational relations (e.g., Rosenau and Czempiel 1992). I have argued that the global arms trade should be understood not as a market but as a network, one that shares some important properties with networked forms of organization studied by sociologists. The sociological approach to world politics, constructivism, despite being broadly compatible with research on the network dynamics in the relations between states, has generally focused on grander themes like state identity formation. In this paper, I restrict my attention to arms-transfer relations, and employ quantitative methods developed for social network analysis in an effort to describe, in a preliminary way, the structure of the small arms trade. Structural analysis, by whatever method, is essential for a fully developed sociological approach to international relations theory and research.

I am not inclined to attach too much significance to the patterns displayed by the various mappings of the arms trade included here, mainly because my data collection effort is still at a fairly early stage. Instead, I will call them suggestive. However, I do believe that the SNA methods employed in this paper are very promising for purposes of subsequent descriptive analyses of more complete (and cleaned) data as they become available. The suite of SNA procedures also include inferential methods, which may also be suitable for the analysis of these

data (see also Hoff, Raftery, and Handcock 2002; Hoff and Ward 2003).

Barabási and Bonabeau (2003) have observed the ubiquity of networks in physical, biological, and social systems, and they point out that many of these networks have “scale-free” structures (see also Barabási 2002). In contrast to random networks, in which links or social ties are distributed randomly across the nodes, scale-free networks consist of some nodes with large numbers of connections and many others with very few connections. The arms trade network is also scale-free; the global pattern of arms-transfer relationships looks less like an evenly dispersed interstate highway system and more like an airline routing system anchored by well-connected hubs. As in other scale-free networks, arms-transfer ties at any given time do not have a symmetric distribution, like a bell-shaped curve, but are highly skewed in the form of a “power law” distribution.¹¹ Barabási and Bonabeau (2003, 64-65) note that power law distributions are driven in part by processes of “preferential attachment,” and can be found in such diverse assemblages as co-starring roles in movies, Internet router connections, biotechnology alliance partners, and citations in the scientific literature.

This structural property of the arms trade network may have implications for research on the transfer of light weapons and military-related contraband by nonstate actors. Mapping the small arms trade is hampered by the secrecy with which many deals are concluded and the shadiness of some of the actors involved. The analysis of network dynamics often requires fairly complete information about the network’s nodes, especially if an aim of the analysis is to identify

¹¹ I have confirmed this for the major weapons trade – where data are pretty reliable – by fitting power-law curves to the annual frequency distributions of arms-transfer ties (both directions). For every year from 1950 to 2000, the estimated curve parameters are statistically significant and the models explain between 64 and 88 percent of the variation from the mean number of ties. These results are available on request.

network vulnerabilities. If the lack of available information makes it necessary to restrict analysis to sampled data, important elements of the network structure may be missed. This danger is less pronounced when examining scale-free networks because even incomplete information is likely to identify the most prominent nodes. Since there is reason to believe that the small arms trade is scale-free, the fact that some of it remains hidden from view need not prevent us from mapping its basic structure. This should come as good news to scholars and activists who are increasingly shifting their attention to the scourge of light weapons.

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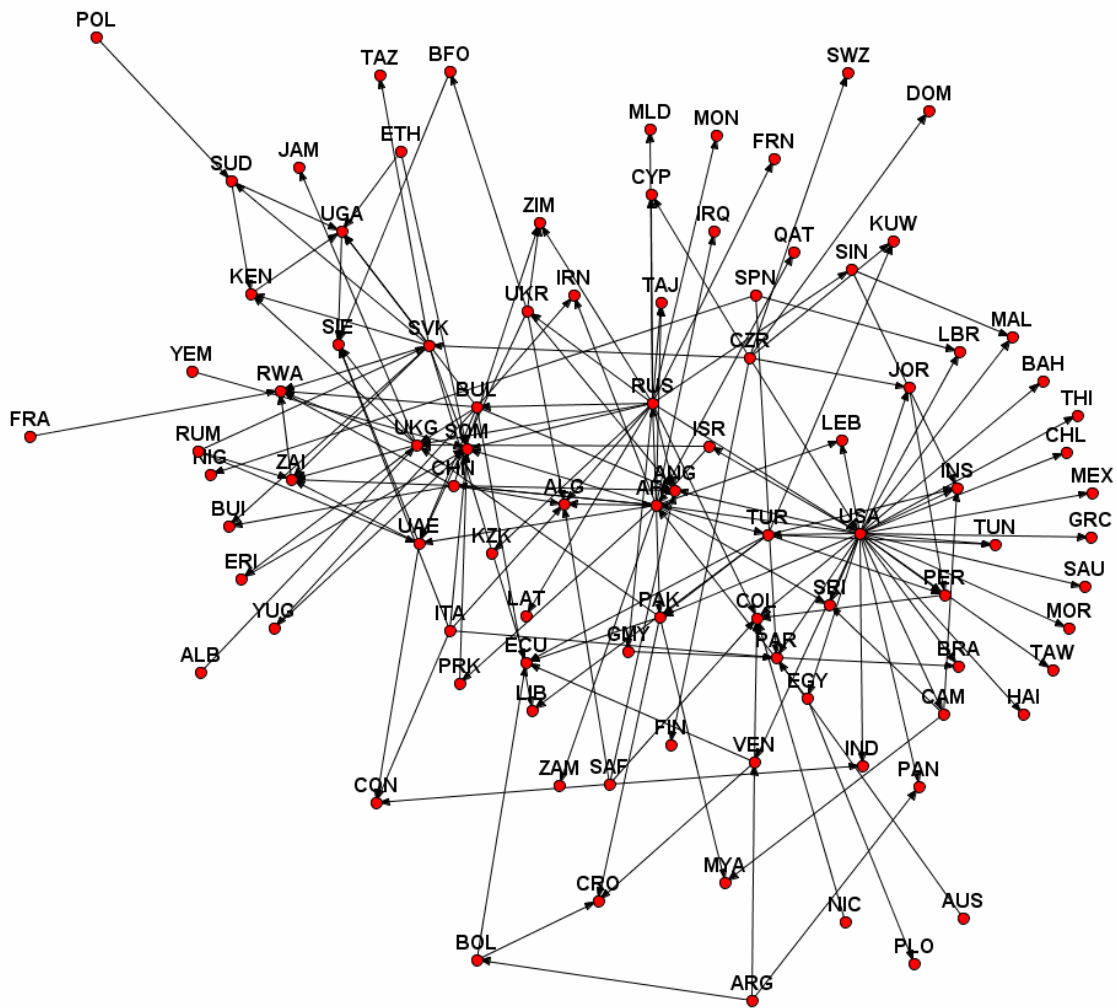


Figure 1: Small Arms Network, 2000-2002

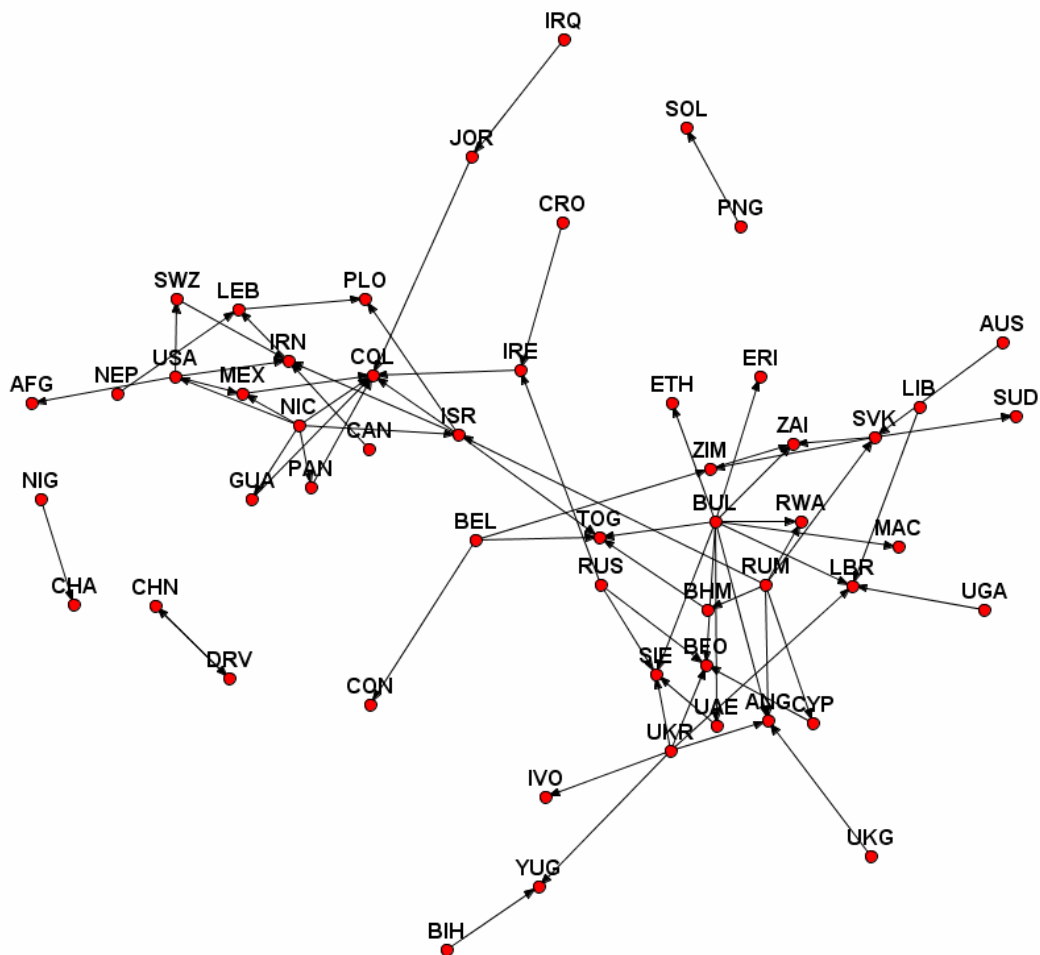


Figure 2: Black Market Arms Network, 2000-2002

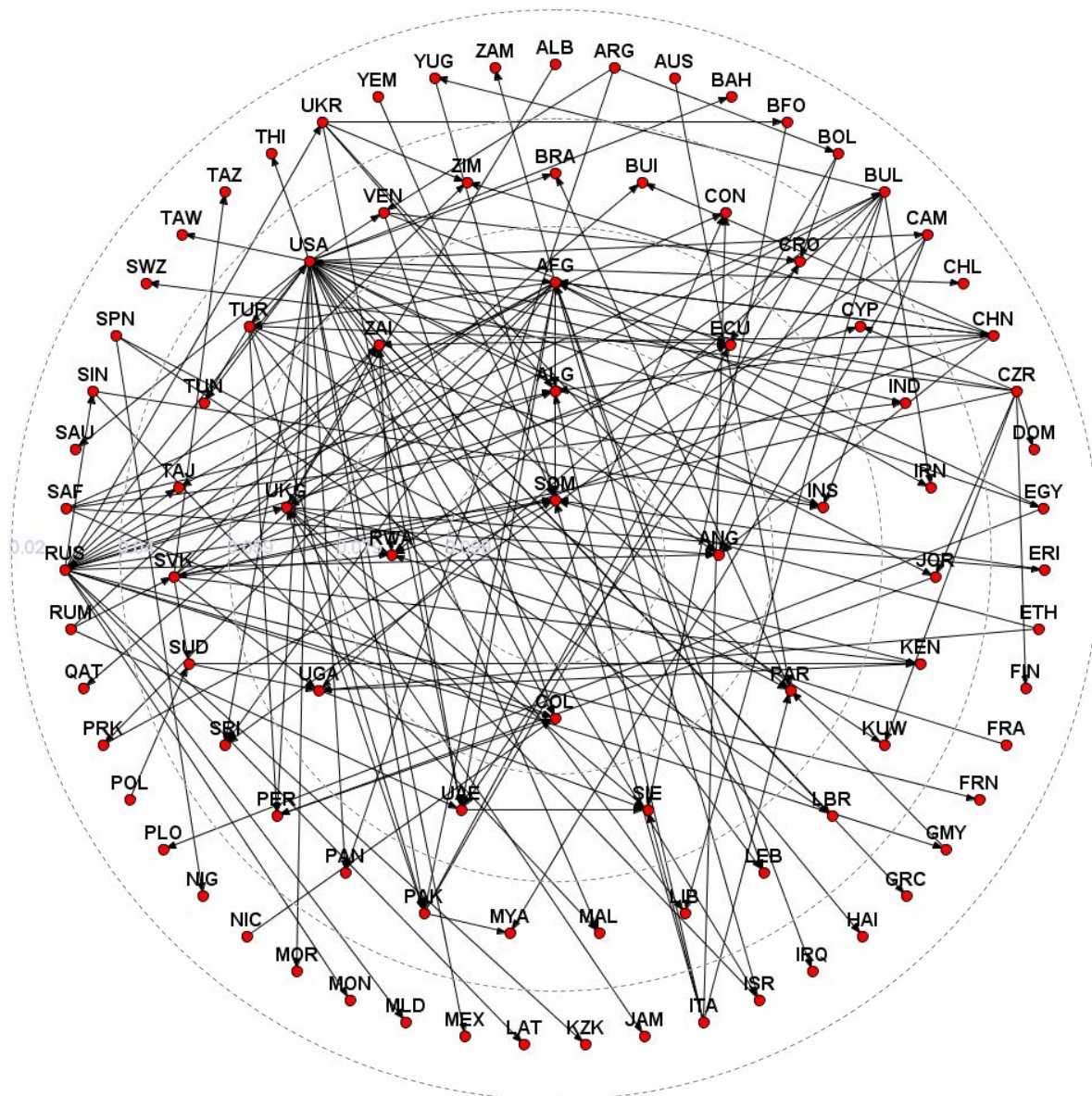


Figure 3: Small-Arms Recipient Centrality, 2000-2002

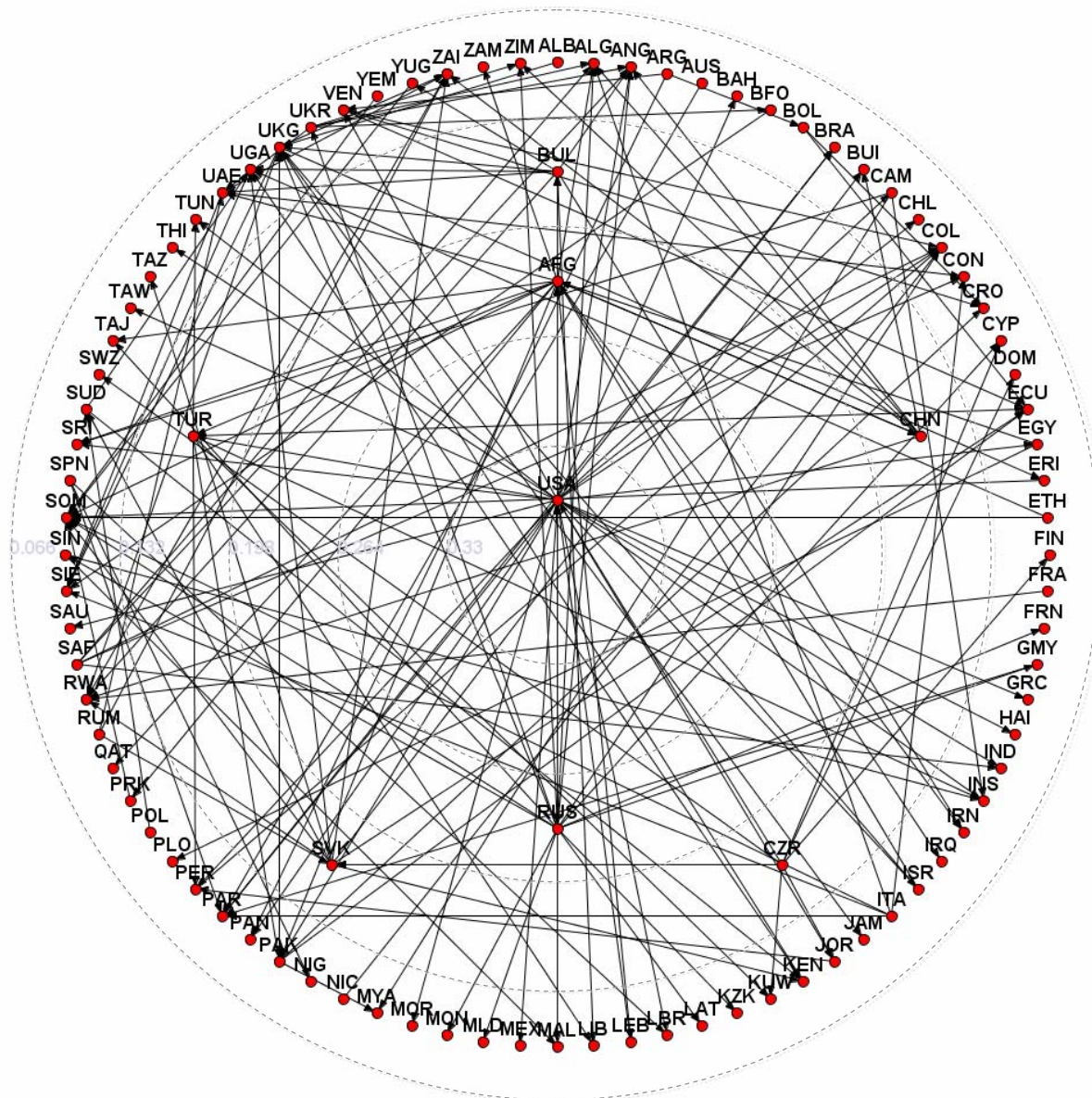


Figure 4: Small-Arms Supplier Centrality, 2000-2002

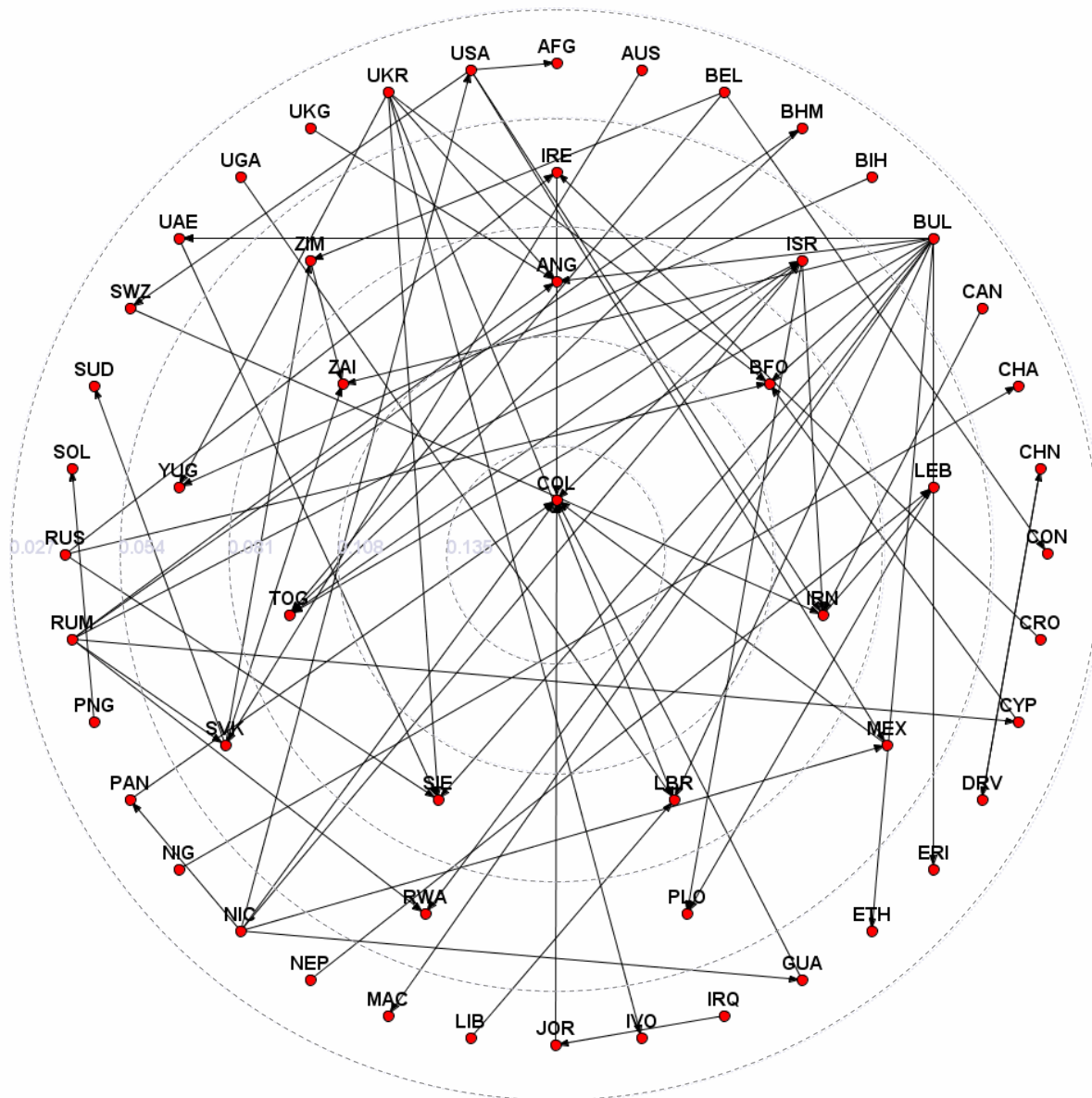


Figure 5: Black Market Recipient Centrality, 2000-2002

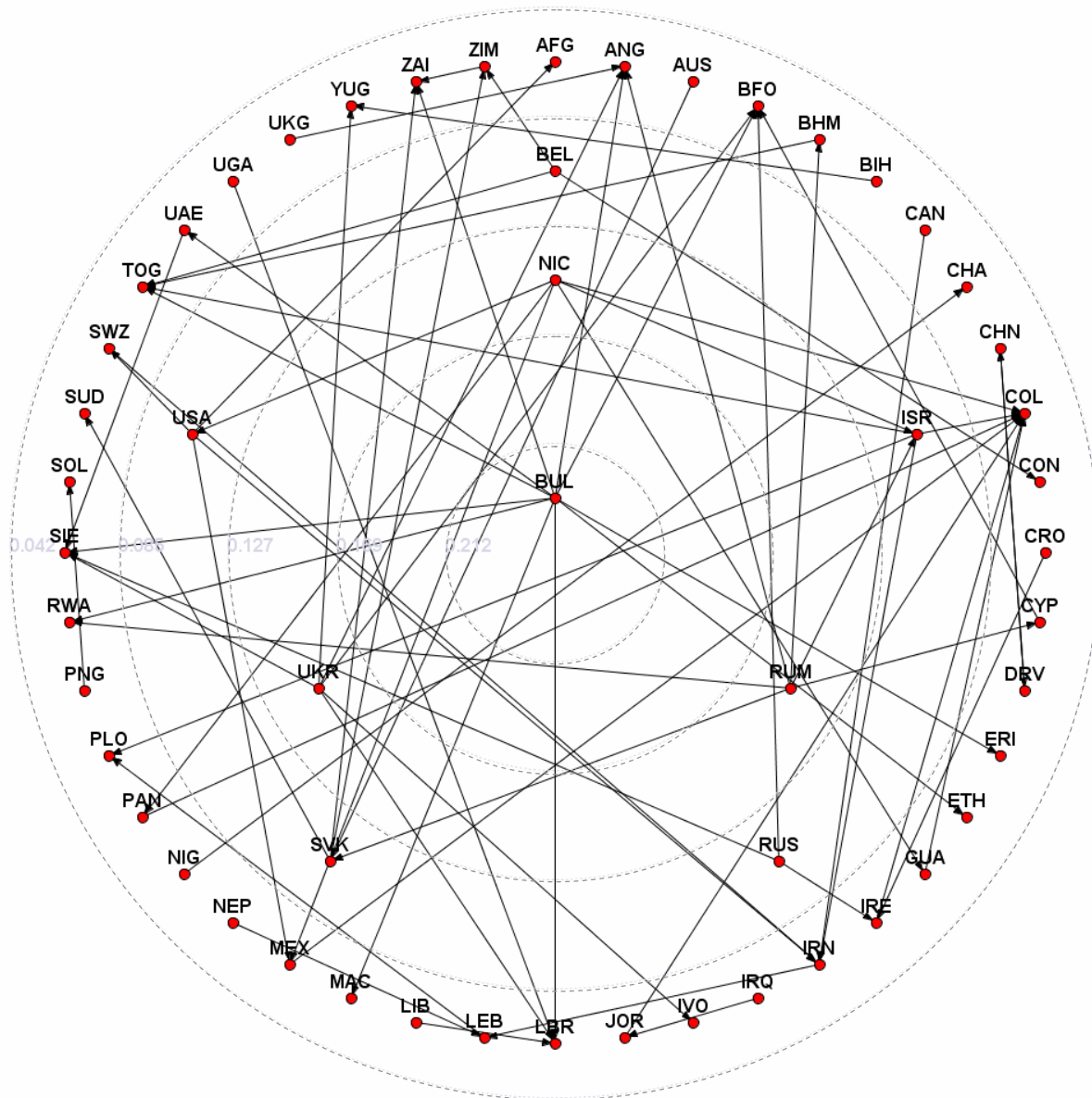


Figure 6: Black Market Supplier Centrality, 2000-2002

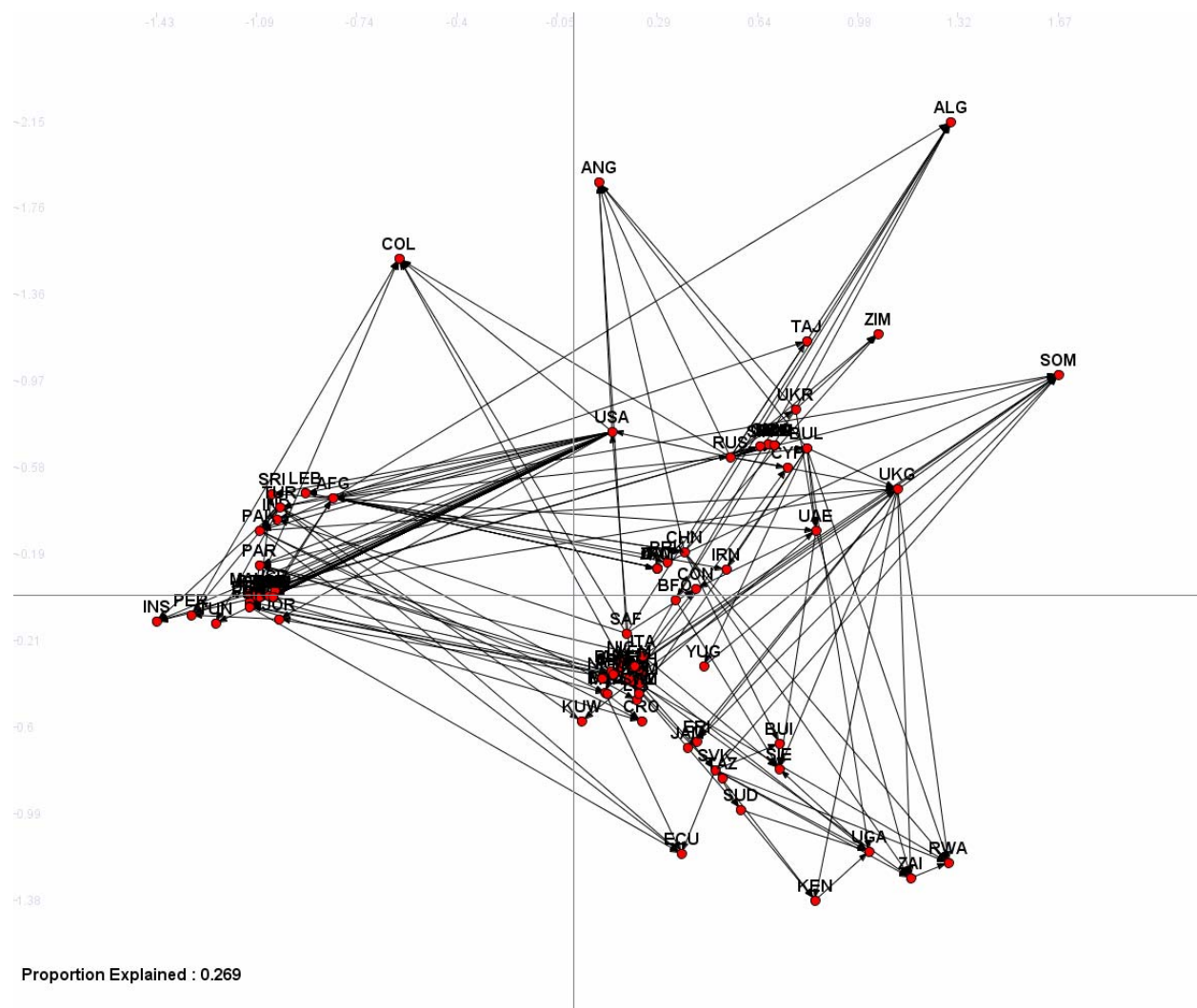


Figure 7: Structural Positions of Small-Arms Recipients, 2000-2002

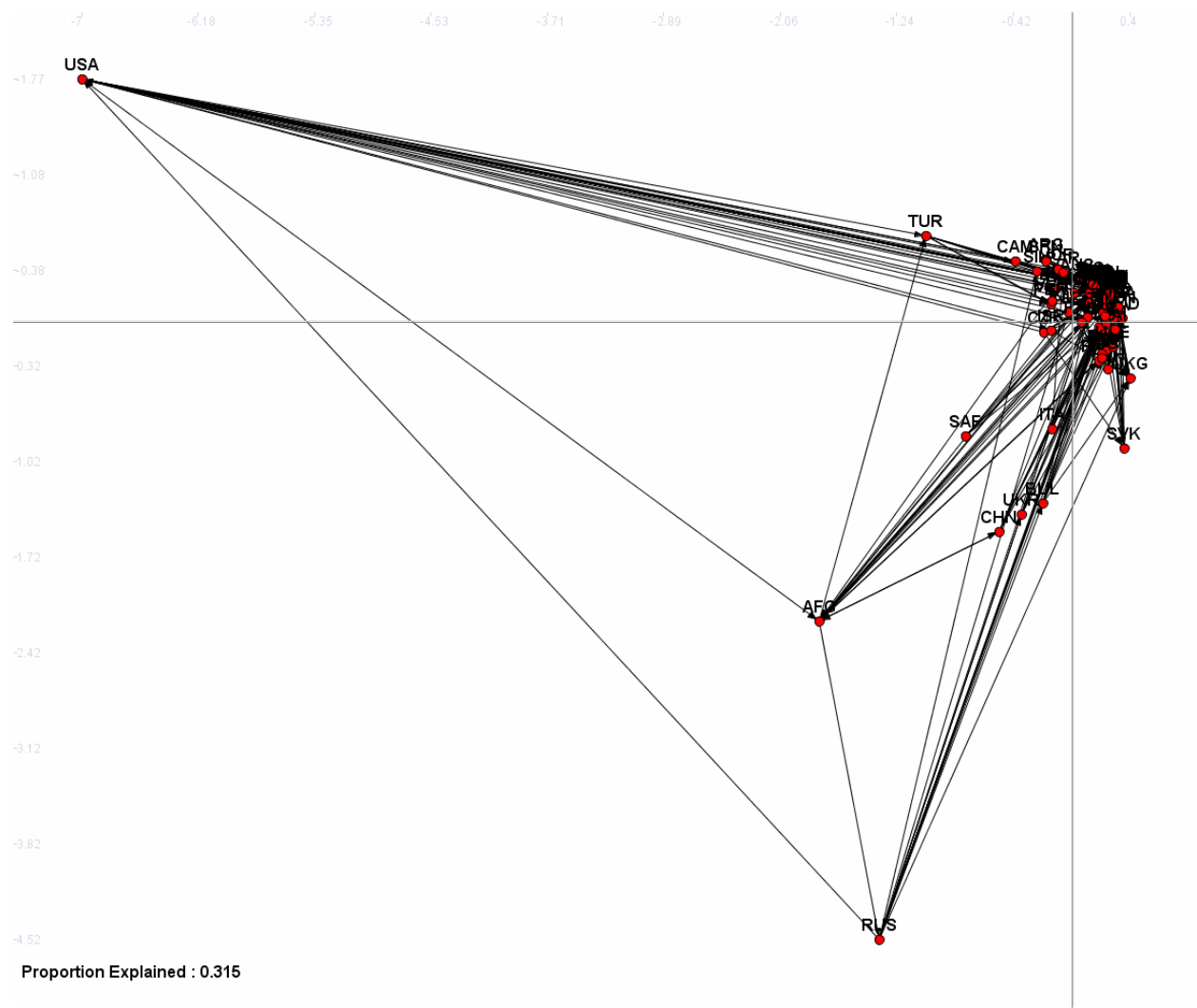


Figure 8: Structural Positions of Small-Arms Suppliers, 2000-2002

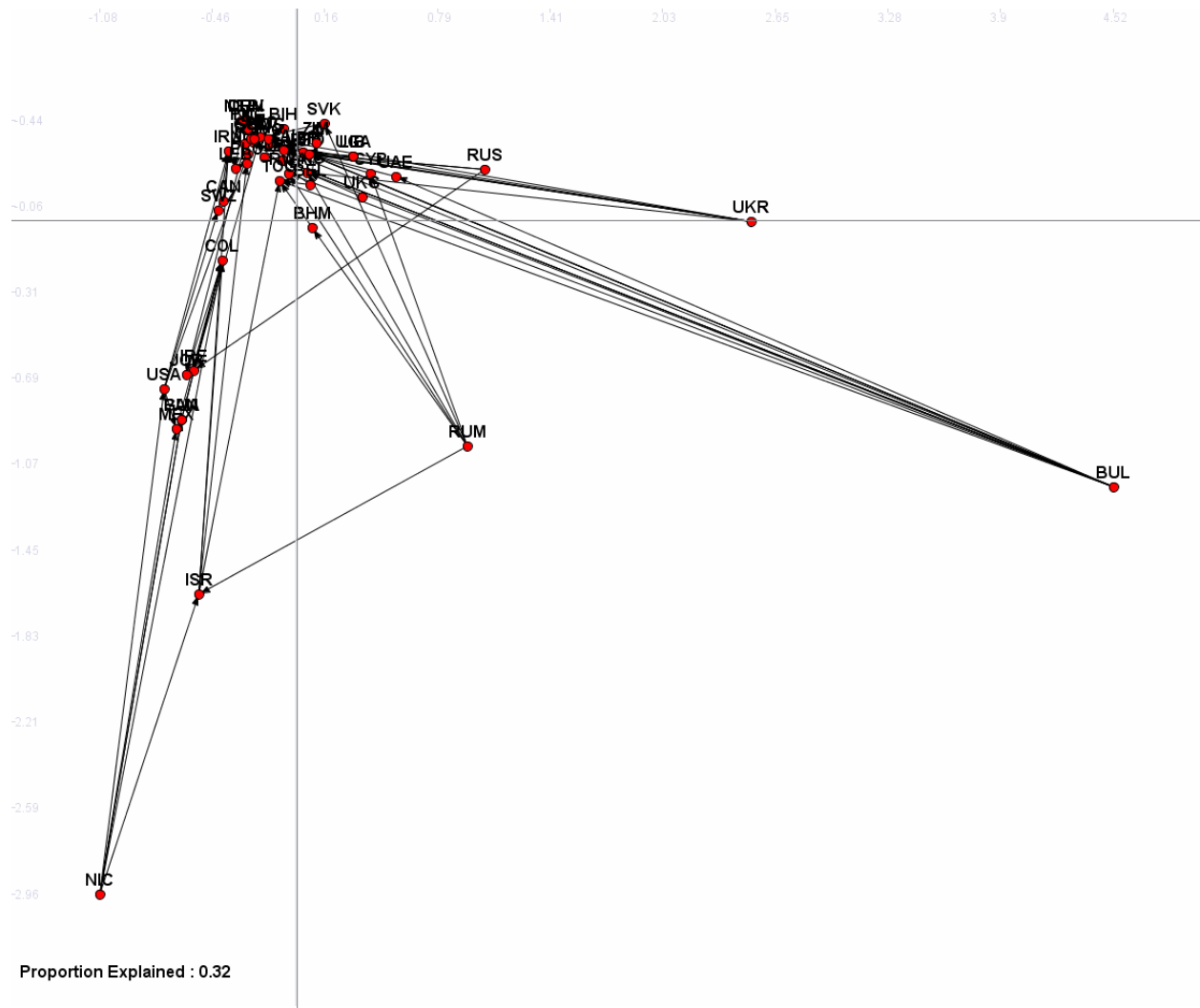


Figure 10: Structural Positions of Black Market Suppliers, 2000-2002